
PRI fault clearing

PRI red alarm (local alarm)

A PRI red alarm (local alarm) can indicate T1 transmission problems, the PRI is disabled, or the PRI card is faulty.

Under any of these alarm conditions, all 24 channels are taken out of service as follows:

- 1 Meridian 1 software checks every 15 minutes to see if a Clock Controller or reference clock error has occurred.

If the 15-minute check finds the PRI in red alarm (local alarm) was a primary clock source, the software switches the Clock Controller to the secondary reference.

- 2 The PRI red alarm (local alarm) faceplate LED is lit.
- 3 Calls on the PRI are disconnected automatically.
- 4 The PRI card and all 24 channels are disabled.
- 5 After a pause of 2.5 seconds, the PRI sends a yellow alarm (remote alarm) signal to the far end.
- 6 The appropriate DTA message is printed and a minor alarm is raised on all attendant consoles within the same customer group.

Channel restoration

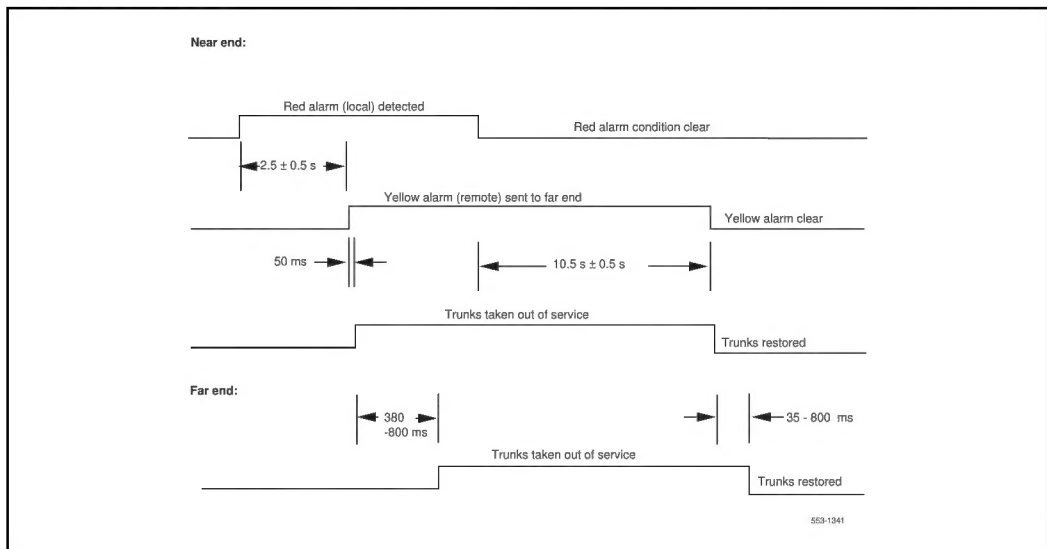
When the alarm condition improves, the PRI is restored to service as follows:

- 1 The Red alarm (local alarm) is cleared.
- 2 After 11 seconds, the PRI stops sending a yellow alarm (remote alarm) pattern to the far end.
- 3 With B-channel signaling (and the D-channel is established), channels are placed into the idle state and made available for calls.

With A&B bit signaling, TIE trunks are made to match the state of the far end (as presented by the T1 port).

Figure 5 shows the progression of the Meridian 1 system red and yellow (local and remote) alarm timers.

Figure 5
PRI alarm timers



Procedure 3**Red alarm status check**

- 1 Check PRI status using the following prompts:
LD 60
STAT (loop)
- 2 Check PRI alarm counters using the following prompts:
LD 60
LCNT (loop)
- 3 See Table 5 for solutions to possible PRI problems.

PRI yellow alarm (remote alarm)

A yellow alarm on the Meridian 1 indicates a problem at the far end (the remote end). The fact that the PRI is receiving the yellow alarm pattern indicates that there is a T1 connection, but the far end is not ready.

When the PRI receives the yellow alarm (remote alarm) signal from the far end, all 24 channels are disabled.

Channel restoration

When the PRI stops receiving the yellow alarm, and the D-channel is established, the channels are placed into the idle state.

Each time a yellow alarm is generated, a counter is incremented. When the yellow alarm 24-hour threshold (prompt RALM in LD 73) is reached, the PRI must be restored to service manually.

Procedure 4

Yellow alarm status check

- 1** Perform a PRI status check.
- 2** Contact personnel at the far end to determine what action they are taking.

When the yellow alarm (remote alarm) 24-hour threshold is reached (DTA006 is printed) do the following:

- 1** Contact personnel at the far end to determine what action they are taking.
- 2** When the far end troubles are cleared, reset the alarm counters and disable, then enable, the PRI. To do this, use the following commands:

LD 60

LCNT loop	list alarm counters
RCNT loop	reset alarm counters
DISL loop	disable loop
ENLL loop	enable loop

PRI problems

The PRI can have any of the following problems. Determine the cause of the problem and follow the recommended actions provided in Table 5.

Table 5
PRI problem solving (Part 1 of 2)

Symptom	Action
No connection to far end. If the T1 cable is not physically connected to the far end, frame alignment errors occur. The channels will be disabled, but the PRI will be in red alarm (local alarm) mode.	Use the Error Counter to verify the T1 transmission from the PRI faceplate (RCV and XMT) to each connection (cross-connect, LD-1 repeater, CSU, and such equipment).
PRI fails self-test	— Reset the PRI card and network loop cable — Add a loopback plug (with pin 1 jumpered to pin 3 and pin 9 to 11) to J14 on the PRI card. — Replace the PRI card — Replace the network card
Far end problems, usually indicated by a yellow alarm (remote alarm).	Do a PRI status check and contact personnel at the far end.
PRI T1 is connected but getting bit rate or frame errors. This can be caused by the following: — a bad T1 cable connection — electrical interference — carrier problems (for example, defective repeater or cross talk)	Use the Error Counter to verify the T1 transmission from the PRI faceplate (RCV and XMT) to each connection (cross-connect, LD-1 repeater, CSU, and such equipment).
Cannot enable the PRI.	Problem due to one of the following: The far end PRI is disabled, indicated by the following: — PRI000PRI is responding — DTA005loop enabled, with yellow alarm — DCH1010DCHI is software disabled — DTI031yellow alarm (remote alarm)

Table 5
PRI problem solving (Part 2 of 2)

Symptom	Action
Meridian 1 initializes and there are no active B-channels.	There is no T1 connection, indicated by the following: — PRI000PRI is responding — DTI030loop enabled with red alarm — DTA021loss of frame alignment for 3s — DCH1010DCHI is software disabled
Configuration settings do not match the far end. These problems can occur during initial start-up. They may be indicated by the following:	When a PRI or ISL trunk interfaces with a DMS-100, Meridian SL-100, or AT&T 4ESS/5ESS and the Meridian 1 initializes, you may have to disable and then enable each B-channel. See that the following Meridian 1 PRI parameters correlate to the far end: Frame format LD 17 prompt: DLOP response: D2, D3, D4, or ESF Line coding LD 17 prompt: LCMT response: B8ZS or AMI D-channel transmission rate LD 17 prompt: DRAT response: 56K, 64KC, or 64KI Yellow alarm (remote alarm) method LD 17 prompt: YALM response: FDL or DG2
— DTA 018, Frame slip out of service limit — DTA 021, Loss of frame alignment for 3 seconds — DCH 1003, D-channel MDL errors	

D-channel problems

D-channel problems are indicated when the DCHI or MSDL releases after being enabled. This applies to both primary and backup D-channels. For example:

LD 96

ENL DCH x	protocol error
DCH 1003	link establishment error
DCH 1006	DCHI released

Procedure 5

D-channel status check

- 1 Check the status of the D-channel's PRI. Clear any PRI problems.
- 2 Contact the far end. If the far end D-channel is down, the DCH1006 message is printed.
- 3 Test the QPC757 DCHI (only) using tests 100, 101, 200 and 201 (the tests must be run in sequential order).
- 4 Print the protocol log using:
LD 96
PLOG DCH x
- 5 Check the DCHI or MSDL to PRI cable.
- 6 Check DCHI card jumper settings.
- 7 Check to see that one Meridian 1 is designated as "master" (usually the larger system), the other as "slave."

Note: This applies only to a Meridian 1 to Meridian 1 configuration.

PRI local loopback test

This test checks the communication path between the QPC414 Network card and QPC720 PRI card. It also checks the leads for the J4. It is often performed when the PRI cannot be enabled. The PRI card must be installed and a cable connecting its J3 connector to a QPC414 Network card.

- 1 Disable the DCHI:

LD 96
DIS DCH x

- 2 Disable the PRI loop:

LD 60
DISL loop

- 3 Disconnect the cable connector from the QPC720 J4 (if attached). Several LEDs will light on the faceplate.
- 4 Attach a female 15-pin connector loopback plug to J4. The loopback plug must have pins 1 and 3 and pins 9 and 11 shorted together.
- 5 Enable the PRI loop:

LD 60
ENLL loop

The green ACT LED will light in a few seconds. If so, the test passed. Continue with the following steps.

If the green ACT light does not come on, retest. Unseat the PRI card between steps 2 and 3.

If the light still does not turn on, try replacing your QPC414 or QPC720 cards or the connecting cable.

- 6 Remove the loopback plug from the J4 connector.
- 7 Replace the cable removed at Step 3.
- 8 Enable the loop:

LD 60
ENLL loop

- 9 Enable the DCHI card:

LD 96
ENL DCH x

PRI self-test

The self-test checks speech path continuity, zero code suppression, remote alarm detection, and A&B bit signaling. This test is performed manually, on a per channel or a per frame (24 channels) basis.

The DCHI and PRI must be disabled before performing the self-test or call processing is disrupted. To perform the self-test on a specific loop do the following:

- 1 Disable DCHI:

LD 96
DIS DCHI x

- 2 Disable the PRI loop and run the self-test:

LD 60
DISL loop
SLFT loop

When the system returns OK, it indicates that the hardware is operable.

- 3 Re-enable the PRI loop:

LD 60
ENLL loop

The D-channel will re-enable automatically.

PRI automatic loop test

The automatic loop test checks the same functions as the self-test. Unlike the self-test, it can be run automatically, as part of the midnight routines.

With the ATLP command set to one the following occurs:

- If all 23 channels are idle at midnight, the system disables the card and performs a self-test on all channels.
- If any of the 23 channels are busy at midnight, the system disables one idle channel, chosen at random, and checks it while the card is enabled.
- With the ATLP command set to zero, only one channel is tested. The channel tested is randomly selected by software; it cannot be specified.

To perform the remote loopback test, use the following:

LD 60
ATLP 1 or 0

When ATLP 1 is entered, the TTY prints out AUTO TEST ENBL. When ATLP 0 is entered, the TTY prints out AUTO TEST DSBL.

Link diagnostic and remote loopback tests

The remote loopback test and the link diagnostic test are performed manually on a per channel or a per frame (23 channels) basis.

Link diagnostic test

The link diagnostic test, also called the far end loopback test, does not test the Meridian 1 PRI. It puts the PRI in loopback mode at the far end so a remote loopback test can be performed on far end equipment. The PRI channel, loop, or frame tested must be disabled.

Remote loopback test

The remote loopback test, also called the near end loopback test, checks the integrity of the PRI from the Meridian 1 system to the far end. The far end must be put into loopback mode before this test can be performed. The PRI channel, loop, or frame tested must be disabled.

Coordinating the tests

When a technician at the far end asks for loopback mode on the Meridian 1, perform the following steps:

- 1 Disable the DCHI:

LD 96
DIS DCH x

- 2 Disable the PRI loop and activate loopback mode:

LD 60
DISL loop
RLBK loop

The QPC720 LBK LED lights.

When a technician at the far end asks for loopback mode on the Meridian 1 to be disabled, perform this step:

Disable loopback mode:

LD 60
DLBK loop

The LBK LED turns off.

When a technician at the far end asks for PRI and DCHI to be re-enabled, perform this step:

Enable the PRI loop:

LD 60
ENLL loop

OK will print out. The D-channel re-enables automatically.

To run the remote loopback test on the Meridian 1, call a technician at the far end and ask for loopback mode at that facility.

When loopback mode at the far end is confirmed, the technician at the far end follows these steps:

- 1 Disable the DCHI:

LD 96
DIS DCH N

- 2 Disable the PRI loop and run the loopback test using the following:

LD 60
DISL L
RMST L

SLFT OK prints out to indicate a successful test.

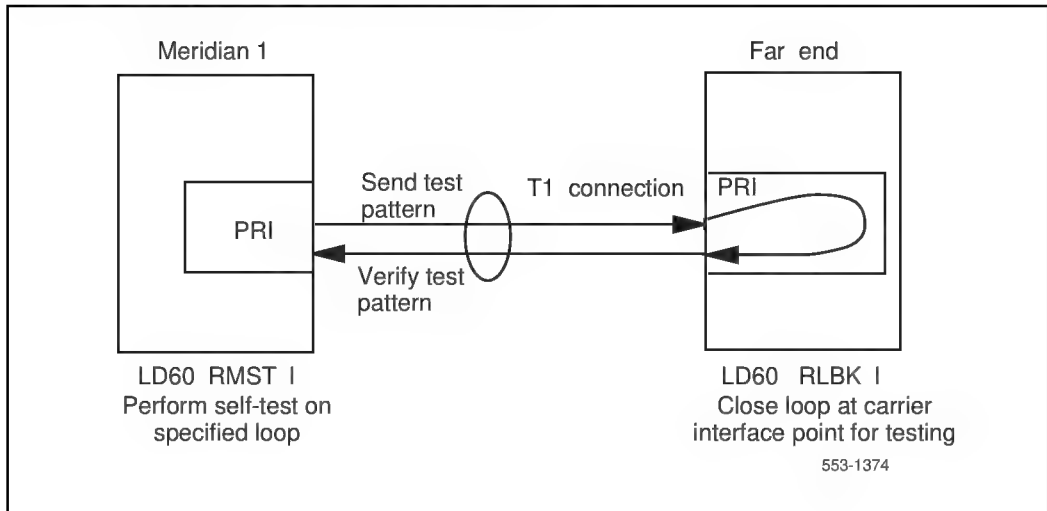
- 3 Call the far end technician to disable the loopback test and to re-enable the PRI and DCHI. The far end technician enables the PRI as follows:

LD 60
ENLL L

OK prints out, and the D-channel re-enables automatically.

Figure 6 shows the relationship between the remote loopback test and the link diagnostic test.

Figure 6
PRI remote loopback and link diagnostic tests



PRI commands (LD 60)

PRI diagnostic commands are used to maintain both PRI and Clock Controller operation. See LD 60 at the end of this document for a list of the PRI card and channel commands in LD 60.

PRI midnight routines

The following PRI maintenance routines should be included in midnight routines:

- LD 30: Network and signaling diagnostic
- LD 60: Digital trunk interface diagnostic
- LD 95: Automatic trunk maintenance diagnostic
- LD 48: Link diagnostic

PRI messages

There are three types of system messages—DTA messages, DTI messages, and PRI messages. These messages are provided at the end of this document.

PRI error detection

There are four types of error detection:

- Yellow (remote) alarm
- Bit error rate
- Frame alignment
- Frame slip

PRI hardware detects BPV or CRC errors. It sends an overflow (OVFL) message to the Meridian 1 CPU each time 1024 BPV or CRC errors are detected. Running the midnight routines prints the number of overflows and clears the counter.

Yellow alarm (remote alarm)

A yellow alarm indicates that the far end (the remote end) is not ready. If the PRI is receiving the yellow alarm pattern, it indicates that there is a T1 connection. When the PRI receives a yellow alarm signal from the far end, all 24 channels are disabled.

The yellow alarm method used depends on the framing format (D2, D3, D4, or ESF) selected. If D2, D3, or D4 framing formats are chosen, the Digit 2 yellow alarm is automatically selected by the software. If the ESF framing format is chosen, the yellow alarm method must be set through service change.

- Digit 2 (DG2) yellow alarm signaling is provided by external circuitry. This alarm is detected when each digit 2 in 63 contiguous channels is logic zero. Use DG2 yellow alarm signaling with D2, D3, and D4 frame formats in Canada and the U.S. Also use DG2 yellow alarm signaling with the ESF frame format in Canada, in compliance with Canadian standard CS03.
- Facility Data Link (FDL) yellow alarm signaling is a 4 Kbps channel. In the U.S., use FDL yellow alarm signaling when the ESF frame format is selected.

When the PRI stops receiving the yellow alarm, channels are placed into the idle state and made available for calls. (In comparison, tie trunks using A&B bit signaling are made to match the state of the far end, as presented by the T1 port.)

Each time a yellow alarm is generated, a counter is incremented. When the remote alarm 24-hour threshold (prompt RALM in LD 73) is reached, the PRI must be restored to service manually.

Maintenance and out-of-service thresholds are used to monitor the performance of PRI bit error rate, frame alignment, and frame slips. These thresholds are defined in LD 73. When a threshold is reached, the following actions are taken:

- Maintenance threshold: PRI warning message is output
- Out-of-service threshold:
 - loop placed in red alarm
 - yellow alarm sent to far end
 - PRI warning message is output
 - minor alarm lit at the customers' attendant consoles

Bit error rate

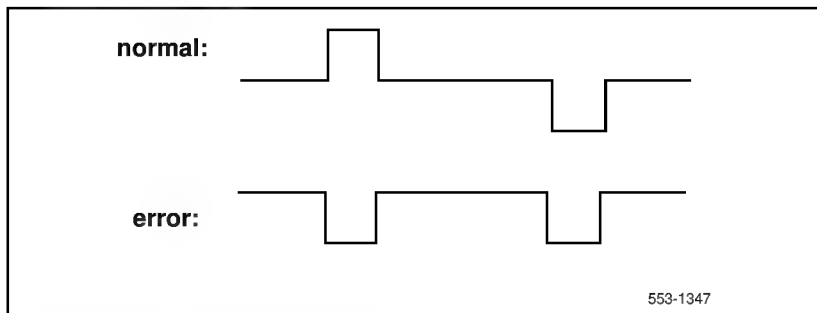
Bit error rate monitoring detects errors in transmission. See Figure 7. There are two methods of bit error rate monitoring, bipolar violation tracking and Cyclic Redundancy Check (CRC). If the D3 framing format is selected in LD 17, prompt DLOP, bipolar violation tracking is implemented. If the Extended Superframe Format (ESF) is selected, CRC is implemented.

Bipolar violation (BPV) tracking

In a bipolar pulse stream, pulses alternate in polarity. A bipolar violation has occurred if, after transmission, two pulses of the same polarity are received in succession (this could be caused by an electrical disturbance such as noise).

Note: Some bipolar violations could result from a far end using B8ZS line coding while the near end expects AMI line coding.

Figure 7
Bipolar violations



Cyclic redundancy check (CRC)

The Extended Superframe Format (ESF) contains a checksum of all the data in the frame. The receiving side uses the checksum to verify the data.

The primary difference between BPV and CRC is that bipolar violation tracking indicates errors on the local span, while CRC indicates errors on an end-to-end span. For example, on a satellite link, BPV only detects errors in the span between the Meridian 1 and the satellite connection. Since CRC traverses the entire span, it indicates an end-to-end bit error rate.

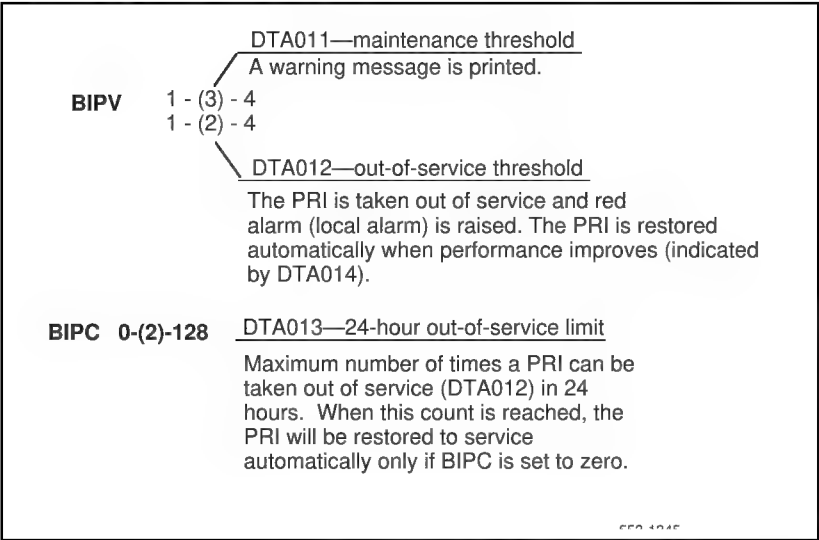
The CRC error counter is displayed with the LCNT L command in LD 60 provided that loop L has been defined with ESF as a framing format. The framing format (D2, D3, D4, or ESF) is selected in LD 17 when the loop is configured.

Bit error rate thresholds

There are three bit error rate thresholds set in LD 73. When a threshold is reached, a DTA message is output. See Figure 8.

- DTA011: Bit error rate maintenance threshold.
- DTA012: Bit error rate out-of-service limit.
- DTA013: Too many bit error rate out-of-service occurrences in 24 hours.

Figure 8
 BIPV and BIPC thresholds



The BIPV thresholds are based on the number of errors in a given time. The threshold levels are shown in Table 6.

For example, if the default BIPV thresholds are used, DTA011 is output when the number of errors exceed 15.4 per second. DTA012 is output when the number of errors exceed 154 per second.

When the error rate improves two levels, the PRI is restored to service unless the 24-hour out-of-service counter was exceeded.

Table 6
BIPV thresholds

Level	Error rate	Elapsed time (seconds)	Number of BPV allowed during elapsed time
least tolerant			
1	>10 ⁻³ (1544 BPV per s)	0.6639	1025
2	>10 ⁻⁴ (154 BPV per s)	.639	025
3	>10 ⁻⁵ (15.4 BPV per s)	6.39	025
4	>10 ⁻⁶ (1.54 BPV per s)	663.9	1025
most tolerant			

Frame slip

Digital signals must have accurate clock synchronization for data to be interleaved into or extracted from the appropriate timeslot during multiplexing and demultiplexing operations. Frame slip monitoring detects frame deletion and repetition errors in clock synchronization. See Figure 9.

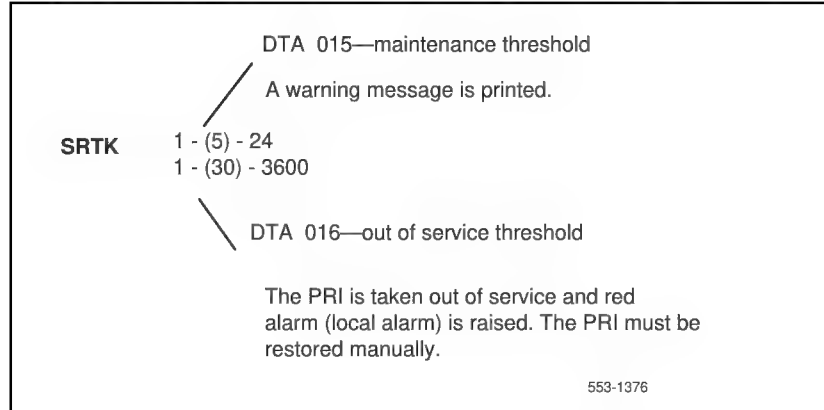
Clock synchronization can be either tracking, on the primary or secondary reference clock, or free run (non-tracking). In LD 73 (prompts PREF and SREF), one PRI may be defined as the primary clock reference. Another may be defined as the secondary clock reference. All others are defined as free run.

PRI hardware detects frame slips in tracking and free run modes. For tracking mode, running the midnight routines prints the number of overflows and clears the counter. For free run mode, running the midnight routines prints the number of frame deletions and repetitions and clears the counters.

Tracking mode There are two thresholds set in LD 73. When a threshold is reached, a DTA message is output as shown below.

- DTA015: Maintenance limit for frame slips in tracking mode.
- DTA016: Out-of-service limit for frame slips in tracking mode.

Figure 9
DTA messages

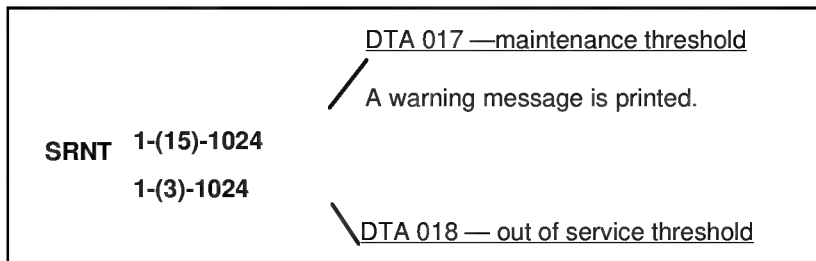


Free run (non-tracking) mode A maintenance threshold and an out-of-service threshold are set in LD 73. When these thresholds are reached, DTA messages are output. An option in LD 73 can enable automatic recovery after the out-of-service limit has been reached. Related DTA messages are described below. See Figure 10.

- DTA017: Maintenance limit for frame slips in free run (non-tracking) mode. The default is 10 slips in 15 seconds.
- DTA018: Out-of-service limit for frame slips in free run (non-tracking) mode without automatic recovery selected. The default is 10 slips in 3 seconds.
- DTA026: Non-tracking frame slip out-of-service threshold reached while monitoring frame slip rate for improvement. Trunks remain out of service. Reset improvement timer.

- DTA028: Slip rate improvement criterion is met. Trunks are brought back into service. Reset improvement timer. (Duration of timer selected in LD 73.)
- DTA029: Slip rate improvement criteria is met. Trunks being returned to service.

Figure 10
DTA thresholds



Automatic recovery After the tracking mode or non-tracking mode out-of-service thresholds are exceeded, the slip rate is monitored for improvement. When the slip rate has improved, the trunks are returned to service.

There are two parameters set in LD 73:

- | | | |
|------|---------------|------------------------------|
| SRIM | (1) - 127 | improvement timer in minutes |
| SRMM | 1 - (2) - 127 | improvement criteria |

If the non-tracking mode maintenance threshold is exceeded SRMM or fewer timers in the duration of SRIM, then the trunks are returned to service. If not, the timer is restarted and monitoring continues.

Frame slippage is considered less important than alarms for loss of frame alignment persisting for 3 seconds, remote alarm, and bipolar violations exceeding the out-of-service threshold. If any of these alarms are reported while the slip rate is being monitored for improvement, then the monitoring stops. The trunks are returned to service only when the more serious alarms clear.

Frame alignment

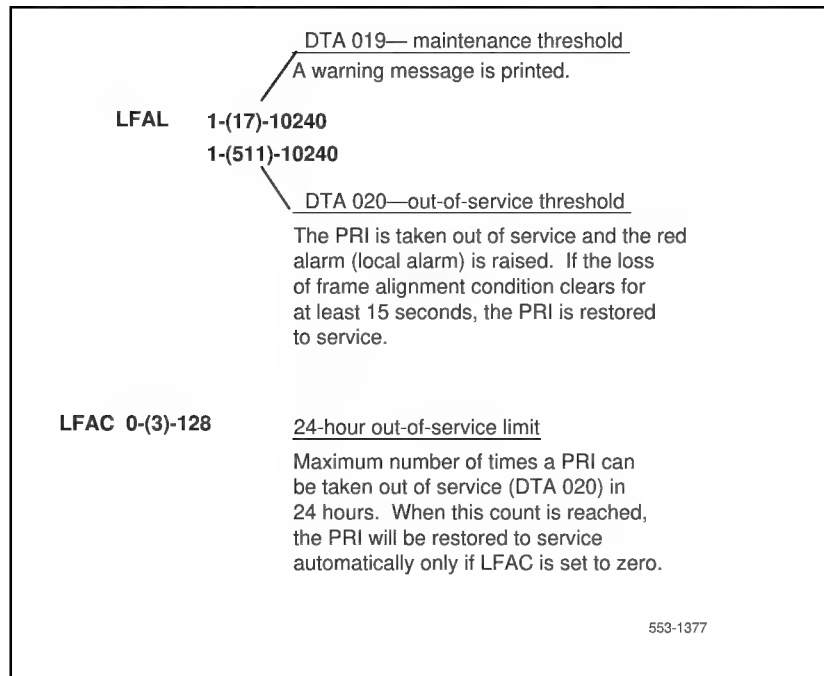
Loss of frame alignment monitoring detects out-of-frame conditions on the DS-1 bit stream. See Figure 11.

Loss of frame alignment thresholds PRI hardware detects out-of-frame conditions. Running the midnight routines prints the number of occurrences when frame alignment was lost and clears the counters.

There are three frame alignment thresholds set in LD 73. When a maintenance or out-of-service threshold is reached, a DTA message is output as shown below:

DTA019: Frame alignment maintenance limit
DTA020: Frame alignment out-of-service limit

Figure 11
Frame alignment

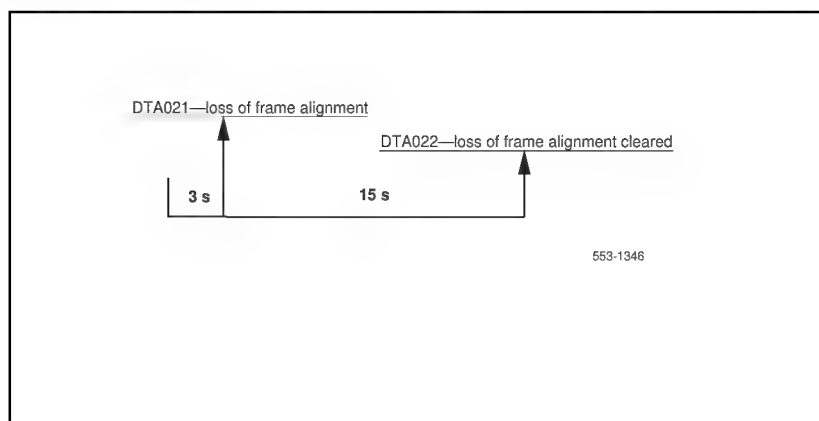


If a loss of frame alignment condition persists for three seconds, the affected PRI loop is taken out of service and a red alarm (local alarm) is raised. See Figure 12.

If the loss of frame alignment condition clears for at least 15 seconds, the PRI is automatically restored to service. The following DTA message is generated:

DTA021: Loss of frame alignment has persisted for 3 seconds.

Figure 12
Frame alignment loss



TN to channel number conversion

PRI channel numbers have an equivalent terminal number (TN). The TN is output instead of the channel number in some Meridian 1 messages. The TN to channel number translation is shown below. Note that the translation is different for the D2 framing format than formats for D3, D4 or ESF.

Terminal numbers are identified in software by Loop (L), Shelf (S), Card (C), and Unit (U) numbers. Each TN is applied to an individual channel on the PRI card. See Table 7 below.

Table 7
PRI channel numbers and equivalent terminal numbers (Part 1 of 2)

Channel number	D2 format TN (S C U)	D3, D4,E SF format TN (S C U)
1	1 4 0	0 1 0
2	1 5 0	0 2 0
3	0 1 0	0 3 0
4	2 1 0	0 4 0
5	0 5 0	0 5 0
6	2 5 0	0 6 0
7	1 1 0	0 7 0
8	1 7 0	1 8 0
9	0 3 0	1 1 0
0	2 3 0	1 2 0
1	0 7 0	1 3 0
2	2 7 0	1 4 0
3	1 3 0	1 5 0
4	1 6 0	1 6 0
5	0 2 0	1 7 0
6	2 2 0	2 8 0
7	0 6 0	2 1 0
8	2 6 0	2 2 0
9	1 2 0	2 3 0

Table 7
PRI channel numbers and equivalent terminal numbers (Part 2 of 2)

Channel number	D2 format TN (S C U)	D3, D4, E SF format TN (S C U)
0	2 8 0	2 4 0
1	0 4 0	2 5 0
2	2 4 0	2 6 0
3	1 8 0	2 7 0
4	3 8 0	3 8 0

Using the error counter

The error counter detects bipolar violations or no-signal periods. It counts, stores, and displays these occurrences to a maximum of 9999.

The PRI fault detection and isolation procedures described in this section are performed using a Thor portable test package, which consists of one each of the following items:

- the Thor TTT2028 Mini-Error Counter, plus operation instruction card
- a cord equipped with a bantam plug at one end and minihooks at the other
- a loopback plug (shorts pins 3 to 1 and 11 to 9 of a 15-pin D connector)

Procedure 6 **Using the error counter**

CAUTION

To prevent injury from voltage on the span, always connect the patch cord into the test set before connecting the other end to the external signal source.

- 1** Plug one end of a patch cord into the input jack of the test set.
- 2** Plug the other end of the patch cord into one of the monitor jacks (RCV and XMT) of the PRI card being tested.

- 3 Monitor the error counter LED indicators as described below:

Table 8
Error counter switch functions

Switch	Function
Display Enable	When held down, the switch enables the counter display and the GOOD and O/R LED displays.
Reset	Used to zero the counter.
Error/Error	Used to select error counting seconds for bipolar violations or error-seconds.

Table 9
Error counter display functions

Display	Function
GOOD	Indicates the presence of an acceptable bipolar signal. (If bipolar violations, missing pulses, or an oscillating line are detected, the indicator is off.)
ERR	Flashes when bipolar violations are detected.
W/M	Indicates no input (absence of pulse) or an oscillating line.
O/R	Over range display turns on when the counter input has exceeded 9999 (the counter resets to 0000).
CNTR	With Error/Error-Second switch in the Error position, the unit counts errors at a maximum rate of 200 per second. With Error/Error-Second switch in the Error-Second position, the unit counts error seconds at a rate of one per second.

Replacing the PRI

Procedure 7 Replacing the PRI circuit card

CAUTION

Firmly touch the metal frame of the cabinet to discharge static electricity from your body before handling circuit cards.

- 1 Disable the D-channel using the following:
LD 96
DIS DCH x
- 2 Disable the PRI loop using the following:
LD 60
DISL loop
- 3 Disconnect cables on PRI faceplate.
- 4 Remove the PRI card.
- 5 Make sure that the new PRI card switch settings are the same as the faulty PRI card.
- 6 Install the new PRI card in the appropriate slot.
- 7 Connect the network loop cable, the carrier interface cable, and the echo canceller cable. If the PRI card is defined as a primary or secondary clock source, connect the Clock Controller cable(s).
- 8 Test the PRI card using the following:
LD 60
SLFT loop If an error message results, see PRI fault clearing.
- 9 Enable the PRI using the following:
LD 60
ENLL loop

